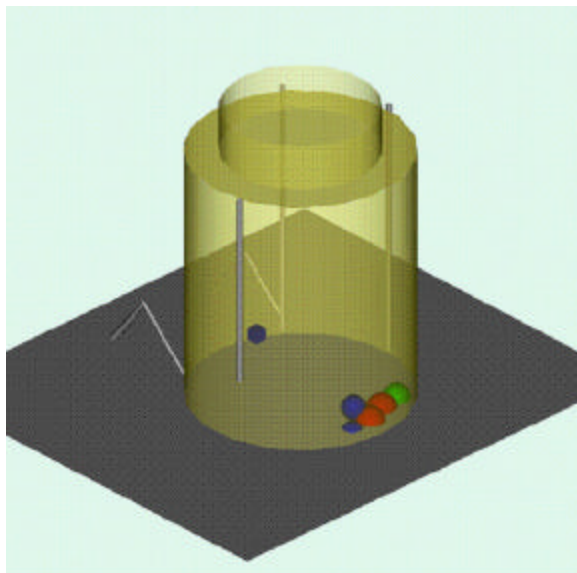




3-D Visual and Gamma Ray Imaging System



SUMMARY

The 3-D Visual and Gamma Ray Imaging System can remotely survey large areas and individual objects for gamma-ray emissions and display the results as combined three-dimensional (3-D) representations of the radiation sources and the equipment.

The technology was deployed at the 221-U Facility for characterization of equipment within the processing cells of the facility. This information was gathered in support of the Canyon Disposition Initiative (CDI) Project. The CDI Project is analyzing alternatives for the final disposition of the five large chemical processing facilities (canyons) at the Hanford Site. The 221-U Facility serves as the pilot facility for the CDI Project.

INNOVATIVE TECHNOLOGY DESCRIPTION

The 3-D Visual and Gamma Ray Imaging System consists of four modules: a sensor head, a portable PC compatible computer, a pan and tilt controller, and a 3-D workstation. The sensor head incorporates a coded aperture gamma-ray imaging detector, a high-resolution

video camera, a laser range finder, and a pan and tilt assembly. The sensor head is controlled remotely by the PC and the pan and tilt controller. The laser range finder and the ability to resolve angles in multiple axes of motion provides information necessary to triangulate for determination of the actual point in space of the imaging target and the gamma detector. Remote operation and control of the sensor head allows for safe image acquisition in high radiation environments, minimizing operator exposure. During image taking operation, a pseudo-color image of gamma-ray-emitting sources is overlain on the video picture of the scene. At each camera location with observed gamma-ray emissions, additional images are taken of key reference features in the scene, along with the measured range and pan and tilt directions for these features. The later images are used to locate the relative camera positions.

The exposure time required to obtain a gamma image is dependent upon several factors, including gamma-ray energy, the distance to the source, and the shape and distribution of the source. From the two-dimensional (2-D) data the dose estimates at the sensor head are calculated. After 3-D processing, the distance to the source obtained by triangulation is used to derive a dose for the source. The system can calculate a dose at any point in space with a default of a "30-cm" dose rate. The 3-D geometry increases the knowledge of the source location and resulting dose estimate.

A table of source locations and "30-cm" dose estimates is generated for each contaminated object. These data are merged with a drawing generated in AutoCAD™ for a visual representation of the object. The resulting merged drawing gives source positions with respect to visually identified objects. The merged drawing can be manipulated to allow the representations to be viewed from different aspect angles.

BASELINE DESCRIPTION

The baseline technology is standard manual surveys performed by trained health physics technicians or 2-D gamma imaging. Manual surveys are time consuming, tedious, and directly expose personnel to radiation. Manual surveys provide only quantifiable results from specific locations, but do not necessarily identify the source locations. 2-D gamma imaging does not include range finding and triangulation components needed to resolve the exact location of radiation sources.

DEPLOYMENT DESCRIPTION

The 3-D Visual and Gamma Ray Imaging System was used to survey a portion of the 221-U Facility and provide visual and radiation measurements of contaminated equipment located within the facility. The GAMMAMODELER™ system software was used to transform extended sources into a series of point sources, locate in three dimensions the positions of these sources, and calculate the dose rates for these sources.

The system performed well during the demonstration and obtained data on 21 objects of interest to the CDI Project. Real-time display of the gamma ray images to the operator showed that seven of these objects had detectable emissions. For these objects, additional views were obtained to allow 3-D rendering. The 3-D rendering showed the sources in relationship to the visual object.

Several of the 221-U Facility cells were imaged. Even with the limited viewing angles that could be obtained for these cases, the 3-D rendering software still allowed 3-D representations of the source locations and strengths to be determined. For cell 10, the system was able to determine the source distributions and intensities at distances greater than 12.2 m (40 ft). These sources are of high dose intensities and would not be accessible to health physics technicians using hand-held instrumentation.

Deployment of the 3-D Visual and Gamma Ray Imaging System was accomplished through the support of the Deactivation and Decommissioning Focus Area, which is managed by the Federal Energy Technology Center.

This work was conducted as part of the 221-U Facility characterization in support of the CDI Project. Characterization information is being obtained to support a Record of Decision for the 221-U Facility. The Record of Decision will establish regulatory and technical precedence for future disposition of the other chemical processing facilities (canyons).

DETAILS OF BENEFITS

The system can be positioned outside the radiation area, thus reducing worker exposure and eliminating extensive shielding. This benefit is more pronounced in high radiation areas. Use of the system can provide information on planning a decontamination process that minimizes worker exposure. Compared to the baseline technology, use of the system leads to reduced labor costs, more reliable data, and significantly less radiation exposure.

Operation of the system is relatively simple, but some training is required to ensure that relevant data are obtained. Currently, the use of the 3-D rendering software requires considerable experience in modeling the source distributions.

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